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A class of linear solvers based on multilevel and supernodal factorization

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Propositions

1. Preconditioning is an essential component to accelerate modern iterative methods for solving large systems of linear equations arising from the solution of computational science and engineering applications. (Chapter 2, this thesis)
2. Although iterative methods can overcome the memory bottlenecks of direct methods, they generally lack the necessary robustness to solve some difficult problems. By pre-processing the matrix using combinatorial algorithms, and by implementing recursive multilevel mechanisms in the solving phase, it is possible to construct robust as well as efficient multi-elimination incomplete factorization preconditioners with a good degree of sparsity and parallelism. (Chapter 3, this thesis)
3. Parameter settings can affect the memory costs and convergence rate of multilevel incomplete factorization preconditioners. There is no universal parameter settings, and the optimal selection for a given problem may be made by trial and error. (Chapters 3, this thesis)
4. The use of overlapping techniques in the pre-processing phase can help to construct more robust and faster convergent multi-elimination incomplete factorization preconditioners. (Chapter 4, this thesis)
5. An implicit approximation of the inverse triangular factors in a multilevel incomplete factorization preconditioner shows a clear advantage over the explicit implementation. (Chapter 5, this thesis)
6. Exposing dense matrix blocks in the linear systems during the factorization phase and redesigning the algorithm block-wise may lead to numerically stable multilevel solvers that can maximize computational efficiency on modern cache-based computer architectures. (Chapter 6, this thesis)
7. People would gain much from doing a doctorate, and there is much more to come from being a sandwich PhD student, who spends his study period at two different universities.
8. A sandwich PhD student in the Netherlands not just receives top-quality education, he does have a great many chances to have sandwiches for lunch.
9. To do a doctorate requires many qualities, among which persistence is one of the most important ones.